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A STUDY OF HEAVY METALS CONTAMINATION IN SURFACE AND GROUND WATER OF RURAL AND URBAN AREAS OF KAKINADA, EAST GODAVARI DISTRICT, A.P

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ABSTRACT

The present study was aimed to assess the water quality of Heavy Metals in Surface and Ground Water of rural and urban areas of Kakinada, East Godavari District (A.P.). Kakinada city is governed by Municipal Corporation and is situated in Kakinada Urban Region. A total number of 29 water samples (9 surface and 20 ground water samples) were collected from different locations of study area at a particular distance during the year of 2012-2013 and analysed for various heavy metals such as As, Cr, Cd, Cu, Fe, Mn, Hg, Pb, Zn and Ni.

The results showed that in surface water varied from the ranges of As, Cr, Cd, Cu, Fe, Mn, Hg, Pb, Zn and Ni – BDL, BDL, 0.0012 to 0.0013, 0.018 to 0.020, 0.51 to 0.52, 0.120 to 0.124, BDL, 0.002 to 0.008, BDL, and 0.009 to 0.018 mg/l, respectively. In ground water the concentration of these metals were found in the ranges of As, Cr, Cd, Cu, Fe, Mn, Hg, Pb, Zn and Ni, - BDL, BDL 0.0011 to 0.0020, 0.008 to 0.042, 0.22 to 02.16, 0.016 to 0.081, BDL, 0.011 to 0.032, BDL, and 0.006 to 0.019 mg/l, respectively.

KEYWORDS: Ground Water, Heavy Metal, Kakinada, Sampling Stations, Surface Water

INTRODUCTION

Water is one of the most essential substances needed to sustain human life, animals, plants and other living beings. Without water no life is possible on earth. Now days, water pollution is a burning issue of all over the world. The situation of water pollution in India also reaches into alarming position. All the water resources of our country such as rivers, lakes, ponds as well as ground water have become much more polluted. Adequate water resources for future generation is not only a regional issue but also a global concern. In our country fresh water wealth is under threat due to the influence of naturals & human activities. By the term “heavy metals” we usually refer to any metallic element that contain a relative high density and applies to the group of metals and metalloids with atomic density greater than 4 g/cm3. Heavy metals are environmentally stable, non-biodegradable and tend to accumulate in plants and animals causing chronic adverse effects on human health.

Antropogenic activities such as urbanization, industrillisation, transportation, indiscriminate use of fertilizer, insecticide, pesticide, Improper disposals of sewage and solid wastes material containing toxic chemicals as well as natural process such as precipitation inputs erosion and weathering of crystal materials increases the contents of these elements in soil and water (Simeonov et al. 2003). However some of the metals like Cu, Fe, Mn and Ni are essential as micronutrients for plants and microorganism while other metals like Pb, Cd and Cr are proved detrimental beyond a certain limits (Marschner 1995, Bruins et al. 2000).

STUDY AREA

Kakinada is one of the fastest developing cities in Andhra Pradesh with a population of 3 lack 13 thousands in 2011 in urban agglomeration, registering a growth of 5% over the past decade. Kakinada Rural is a Mandal in East Godavari District of Andhra Pradesh State, India. Kakinada Rural Mandal Head Quarters is Kakinada Rural town. 469 KM from State capital Hyderabad towards west. Kakinada Rural Mandal is bounded by by Kakinada Mandal towards North, Karapa Mandal towards west, Pedapudi Mandal towards west, Samalkota Mandal towards North. Kakinada City, Samalkot City, Peddapuram City, Pithapuram City are the nearby Cities to Kakinada Rural. Kakinada Rural consist of 38 Villages and 21 Panchayats. Penumarthi is the smallest Village and Sarpavaram is the biggest Village. It is near to Bay of Bengal. There is a chance of humidity in the weather. The Kakinada city is the capital of East Godavari District of Andhra Pradesh on the central east coast of India. The present study deals with the assessment of the quality of ground water in industrial areas of Kakinada, Andhra Pradesh, India. Kakinada is situated between the latitude 16°57' North and longitude 82°15' East.

Therefore it is necessary to monitor these metals for safety assessments of the environment and human health. It is rich in small water bodies and most of all agricultural lands are dependent on these water source.

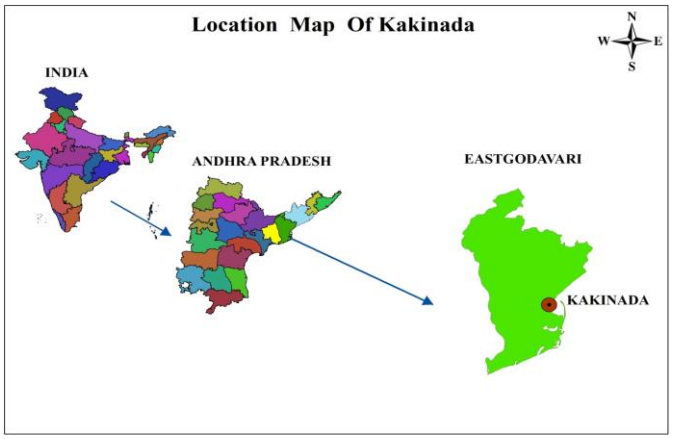

Figure 1: Location Map of the Study Area

MATERIALS AND METHODS

The total number of 29 water samples (9 surface and 20 ground water samples) were collected in 1L precleaned polythene bottles in the year of 2012-2013 as per standard methods mentioned in the APHA (1995). The surface water samples collected from ponds, water tank and canals, while ground water samples taken from hand pumps of the selected area and immediately brought to laboratory and preserved with the addition of 2 ml/l nitric acid in each samples to avoid precipitation of the metals. These samples were concentrated and subjected to nitric acid digestion. Selective heavy metals such As, Cr, Cd, Cu, Fe, Mn, Hg, Pb, Zn and Ni were determined by Atomic Absorption Spectrophotometer (Parkin Elmer Analyst 100).

RESULTS AND DISCUSSIONS

The results of various heavy metal analysis in surface and ground water are listed in table I and II respectively. Lead (Pb) is a soft metal such that has been known many applications of it over the years. During present investigation, lead metal ranged from BDL, 0.002 to 0.008 mg/l in surface water and BDL, 0.011 to 0.032 mg/l in ground water samples. The out of twenty water samples in eight ground water samples observed in Pb above permissible limit, 0.01 mg/l recommended by WHO for drinking water. The possible sources of Pb are combustion of gasoline, its uses in alloys, old

lead pipe line from which water is supplied, idol immersion activities, uses of lead arsenate as pesticide as well as its uses in paints, pigments and lead storage batteries. Bajpai, et. al. (2009) studied water quality of Bhopal lakes and found higher concentration of lead after idol immersion activities.

During present study iron (Fe) content were found in the ranges of BDL, 0.51 to 0.52 mg/l in surface water and BDL, 0.22 to 2.16 mg/l in the ground water samples. The Fe level 0.3 mg/l recommended by WHO.

The high concentration of iron in the study area is due to the presence of Iron pipes through water got the Iron content in the whole region. Khan, et. al. (2005) studied the drinking water quality of Delhi and reported Iron between the ranges of 0.62 to 3.47 mg/l.

Manganese (Mn) is one of the more abundant element in the earth's crusts and is widely distributed in soils, sediments, rocks and water. In present studies manganese ranged from BDL, 0.120 to 0.134 mg/l in surface water and BDL, 0.016 to 0.081 mg/ l in ground water samples.

Table 1: Status of Heavy Metals in Surface Water Units (mg/lit)

S.No	Name of the Sampling Stations	As	Cr	Cd	Cu	Fe	Mn	Hg	Pb	Zn	Ni
1	Kulai water tank	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.002	BDL	0.01
2	Pindala water tank	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01
3	Jagannaick puram (Upputeru)	BDL	BDL	0.0012	BDL	0.51	0.12	BDL	0.006	BDL	0.01
4	Indrapalem - Z Bridge canal	BDL	BDL	0.0013	0.018	0.51	0.116	BDL	0.004	BDL	0.01
5	Madhavapatnam canal	BDL	BDL	0.0012	0.02	0.52	0.115	BDL	0.003	BDL	0.01
6	Boat club pond	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01
7	Boddu water tank (Turangi)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.002	BDL	0.02
8	Industrial area canal (Opp to : Agarwal Industry)	BDL	BDL	BDL	0.045	BDL	0.134	BDL	0.008	BDL	0.02
9	Santha water tank	BDL	BDL	BDL	BDL	BDL	0.111	BDL	BDL	BDL	BDL

BDL = Below Detectable Limit

Table 2: Status of Heavy Metals in Ground Water Units (mg/lit)

S.No	Name of the Sampling Stations	As	Cr	Cd	Cu	Fe	Mn	Hg	Pb	Zn	Ni
1	Chidiga (Rural)	BDL	BDL	BDL	BDL	0.22	0.051	BDL	BDL	BDL	BDL
2	Toorangi (Rural)	BDL	BDL	BDL	0.012	0.26	0.033	BDL	0.026	BDL	BDL
3	Indrapalem (Rural)	BDL	BDL	BDL	BDL	0.22	0.012	BDL	0.022	BDL	0.01
4	Vakalapudi (Rural)	BDL	BDL	0.0022	0.038	0.22	0.042	BDL	BDL	BDL	0.02
5	Kovvada (Rural)	BDL	BDL	BDL	0.029	BDL	0.016	BDL	0.011	BDL	BDL
6	Ramanayya peta (Rural)	BDL	BDL	BDL	0.012	0.55	BDL	BDL	0.016	BDL	0.02
7	Sarpavaram (Rural)	BDL	BDL	0.0018	0.008	0.22	0.21	BDL	0.032	BDL	0.02
8	Valasapakala (Rural)	BDL	BDL	0.0022	0.036	2.16	0.021	BDL	0.028	BDL	0.02
9	Panduru (Rural)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
10	Ganganapalli (Rural)	BDL	BDL	BDL	0.022	0.81	BDL	BDL	BDL	BDL	0.01
11	Balaji water tank (Urban)	BDL	BDL	0.0016	0.021	0.36	0.045	BDL	0.016	BDL	0.01
12	Two Town (Urban)	BDL	BDL	0.0011	0.042	BDL	0.038	BDL	0.03	BDL	BDL
13	Bhanugudi (Urban)	BDL	BDL	BDL	0.029	0.32	0.081	BDL	BDL	BDL	BDL
14	JNTU Kakinada (Urban)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.022	BDL	0.01
15	Glass House (Urban)	BDL	BDL	0.002	BDL	BDL	0.018	BDL	0.026	BDL	0.01
16	Jagannaick Pur (Urban)	BDL	BDL	0.0024	0.026	0.44	0.011	BDL	BDL	BDL	0.01
17	100 Building Center (Urban)	BDL	BDL	0.0013	BDL	BDL	0.038	BDL	0.028	BDL	BDL
18	Sri Nagar (Urban)	BDL	BDL	0.0011	BDL	BDL	0.016	BDL	0.011	BDL	0.01
19	Ramarao peta (Urban)	BDL	BDL	0.0013	0.036	BDL	0.036	BDL	0.016	BDL	0.01
20	Gandhi nagar (Urban)	BDL	BDL	0.0012	0.041	BDL	0.024	BDL	BDL	BDL	0.01

BDL = Below Detectable Limit

The concentration of copper (Cu) varied from the ranges of BDL, 0.018 to 0.020 mg/l in surface water and nil to 0.058 mg/l in ground water samples. All surface and most of ground water samples contained copper within desirable limit, 0.05 mg/l recommended by BIS (10500-1991). Only 15% ground water samples contained copper above desirable limit but these values are well within permissible limits, 1.0 mg/l prescribed by BIS and WHO. The primary import pathway of copper to soil or waste disposal fertilizer application and atmospheric deposition. Bhavana, et. al., (2009) studied the water quality of Narmada river and found that most of water surface contained copper within permissible limits.

The concentration of Nickel (Ni) ranged between BDL, 0.009 to 0.018 mg/l in surface water and nil to 0.019 mg/l in ground water samples. In both cases the concentration of nickel where found well within permissible limit, 0.02 mg/l recommended by WHO for drinking water. Here it is found out that nickel content was observed below detectable limit in 10% ground water samples (7 samples out of 20). Abida Begum, et.al. (2009) studied the water quality of Madivala lakes of Bangalore, Karnataka and found that most of water samples contained nickel within permissible limit.

Cadmium (Cd) metal were found in the ranges of BDL, 0.0012 to 0.0013 mg/l and BDL, 0.0011 to 0.0020 mg/ l in surface and ground water samples respectively. Cadmium metal was not detected in 15% ground water samples. Here it is reported that 75% surface (3 sample out of 5) and 85% ground water samples (17 samples out of 20) contained cadmium within permissible limits recommended by BIS and WHO for drinking water. The high concentration of cadmium in some water samples of the study area may be attributed to the run off from the agricultural fields where pesticides as well as cadmium containing phosphatic fertilizer have been used. Its accumulation in water may also be possible due to paint-pigments. Lokeshwari, et. al. (2006) studied. The impact of heavy metals conglomeration of Bellandur lakes on soil and cultivated vegetation and reported cadmium concentration 23 time higher than the Maximum permissible limit. Tiller, K.G. (1989) observed that the amount of cadmium increase in the agricultural fields due to the use of pesticides.

CONCLUSIONS

- From the above studies, it is concluded that the quality of surface and ground water varied from place to place.
- Ground water is comparatively more polluted than Surface water.
- However the situation is not too worst but the higher concentrations of heavy metals in some sampling stations indicate that without proper treatment of water is not suitable for domestic applications.

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